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Exporting and innovating among emerging market firms: The moderating role of institutional development

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Abstract
Building on the recombinatory view of innovation and an institutional perspective, this study investigated how the level of institutional development in a firm's home region and the institutional distance between the home and export markets might influence the effectiveness of learning through exporting. For exporters in emerging economies, more support for R&D and better-developed market intermediaries at home were found to enhance the positive effect of exporting on firms' innovation, while market openness in the home region tends to dampen it. Exporters exporting more to other emerging economies tend to be more innovative than those exporting more to advanced markets. These findings arise from an empirical study of exporting and innovation among Chinese manufacturers.
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INTRODUCTION

Exporting provides firms an opportunity to access knowledge from elsewhere, which can serve as an effective means of organizational learning (Bratti & Felice, 2012; Lileeva & Trefler, 2010; Salomon & Jin, 2010). Governments in emerging markets (EMs) actively encourage exporting and consider export performance as one of the most important indicators of firms' technological sophistication (Thun, 2006). However, EM exporters find it hard to translate their information advantage into an innovation advantage (Navas-Aleman, 2011; Yao, 2012). This is not surprising, as prior research has found that such translation usually requires strong technological competence, superior absorptive capacity, and close and direct relationships with technologically sophisticated customers (Li, Chen & Shapiro, 2010; Salomon, 2006; Smith, 2014), all of which EM exporters are typically not endowed with. While it is difficult for EM firms to overcome such limitations, macro-level institutional development in EMs might help such firms to benefit more from what they learn through exporting.

Prior research's focus on firm-level, internal factors specific to exporters might have obscured how macro-level, external institutions can help or hinder EM exporters' innovation (Corredoira & McDermott, 2014). Building on the recombinatory view of innovation and the institutional perspective, this study was designed to explore to what extent aspects of institutional development in a firm's home region and institutional distances between the home and destination countries might influence EM firms' ability to benefit from exporting. Although institutional development has been proceeding in most EMs in recent years, not all of the developments are equally beneficial for their firms (Cuervo-Cazurra & Dau, 2009; Kim, Kim & Hoskisson, 2010).

An important reason why exporters tend to be more innovative is that they have access to overseas knowledge via value chain activities integrated into the global market (Alcacer & Oxley, 2014; Bratti & Felice, 2012; Lileeva & Trefler, 2010). But such an information advantage can be offset if firms can get similar access without exporting. A home market that is open to the cross-border transfer of capital, goods, and knowledge allows for such offsetting. Firms may benefit from knowledge spillovers taking place within the home region via demonstration effects and personnel mobility, or seek foreign knowledge by importing technology and capital goods, collaborating with multinational investors or even reaching out through outward foreign direct investment (FDI) (Bertschek, 1995; Braga & Willmore, 1991; Chang & Xu, 2008; Khanna & Palepu, 2010; Luo & Tung, 2007). Therefore, while market openness may improve the innovation abilities of local firms in general, it weakens the information and innovation advantages gained through exporting.

Getting access to overseas knowledge is only the first step. Prior research has shown that innovations often involve the novel recombination of knowledge which was previously considered unrelated (Fleming, Chen & Mingo, 2007; Hargadon & Sutton, 1997). EM exporters need to process the knowledge they acquire through exporting, which can involve extensive adaptation, combining it with relevant local knowledge (Corredoira & McDermott, 2014; Herrigel, Wittke & Voskamp, 2013). Home institutions that support local R&D activity tend to create a pool of technologically capable local entities, serving as an important source of local knowledge (Corredoira & McDermott, 2014). Effective market intermediaries in the home region facilitate the combination of overseas and local knowledge by facilitating knowledge flows between exporters and local entities (Khanna & Palepu, 2010; Kostinets, 2014; Nicholas & Shimizu, 2013; Zhang, Li, Hitt & Cui, 2007).

In addition to the level of institutional development at home, the institutional distance between home and overseas markets may also influence the relationship between exporting and innovation performance. Exporting to countries with a similar level of institutional development may make it easier to combine local knowledge with the knowledge acquired through exporting and thus to innovate (Lane & Lubatkin, 1998). This is especially likely to be true for EM firms, who suffer from poor technological capabilities and limited international experience.

The results of this empirical study of Chinese manufacturers largely support these arguments. Export intensity was found to be positively related with the output of new products. The relationship was stronger in provinces where governments invest more in R&D and where market-supporting intermediaries are better developed. In provinces where market is more open to the rest of the world, the relationship was dampened. Those Chinese exporters exporting a larger proportion of their products to other emerging economies tend to be more innovative than those exporting more to advanced markets. Further analysis showed that Chinese exporters' innovation benefited more from exporting to countries with a similar culture, similar levels of knowledge, and similar global connectedness.

This research broadens the application of the institutional perspective in international business research. It extends prior work on learning by exporting by showing that the effectiveness of learning by exporting can be influenced not only by internal, firm-level factors but also by external, macro-level institutions. Market-opening policies, systems supporting innovation, and market intermediary development influence different stages of the journey from exporting to innovating. The first two aspects of institutional development shape the foreign and local resources available for EM firms' innovation, while the third influences the cost of resource recombination. Limited market openness, weak local support for innovation, and weak market-supporting intermediaries can all be considered as aspects of weak institutions which impede development, but efforts to ameliorate them seem not to benefit all firms equally. EM exporters can

take advantage of the isolation of their home region to create arbitrage opportunities and to develop an edge in innovation over their competitors. Market openness constrains such opportunities. Some other aspects of institutional development benefit exporters more than non-exporters, such as government support for local R&D and the development of market intermediaries.

The findings of this study also highlight the importance of considering the dissimilarities or gaps in institutions between the economies involved. The data show that such gaps dampen the effectiveness of cross-border combination of knowledge. Further analysis shows that better absorptive capacity for technology does not reduce the negative effect of institutional distance, indicating that absorptive capacity for technology may not be the only limiting factor. EM firms might need to develop a different sort of absorptive capacity based on the institutional practices they must deal with if they are to make the best use of the knowledge they can gain by exporting to more developed countries.

THEORETICAL BACKGROUND

Exporting and Learning by Emerging Market Firms

The exchange of tangible goods often leads to the transfer of intangible knowledge (Grossman & Helpman, 1993). Exporting firms are usually exposed to new technology and market knowledge overseas that is more diverse than that available at home, if it is available at all. This allows for information arbitrage (Kogut, 1989), and the accumulation of diverse knowledge about markets and technology tends to promote performance among exporters. Early firm-level empirical studies on learning-by-exporting mainly focused on discovering any causal relationship between exporting and firms' productivity (for a review, see Wagner, 2007). The inconclusive findings drove this stream of research to shift its focus in recent years from the effect on productivity to that on innovation (e.g., Chittoor, Aulakh & Ray, 2015; Li et al., 2010). It is believed that innovation "…can more directly measure the outcome of interest – learning by exporting" (Salomon & Shaver, 2005). Today, firm-level empirical studies relating exporting with innovation report reasonably consistent positive results. While firms from both developed countries and EMs have been shown to benefit from exporting in terms of innovation performance (Bratti & Felice, 2012; Damijan, Kostevc & Polanec, 2010; Fafchamps, Hamineb & Zeufackc, 2008; Li et al., 2010; Salomon & Jin, 2008, 2010), the benefits tend to be especially important for the latter (Amsden, 1989, 2001; Hobday, 1995).

Compared with FDI and other routes to internationalization, exporting involves less commitment or risk, and requires less sophisticated management skills (Cassiman & Golovko, 2011). Exporting is therefore the usual first step for EM firms seeking to internationalize their sales (Luo & Tung, 2007). The learning benefits of exporting are one of the reasons why many EM governments encourage exporting with policies such as setting up export-processing zones, export tax incentives, export cartels, and export quality inspection (Amsden, 1989; Wade, 1990). In EMs, learning by exporting takes place in many different ways. For example, in order to ensure the quality and performance of the goods they import, foreign importers may transfer extensive knowledge about production techniques, quality and cost control measures, their customers' needs, and even information about competing products (Evenson & Westphal, 1995; Hobday, 1995; Wu, Sinkovics, Cavusgil & Roath, 2007). But EM firms may not benefit from exporting to the extent that AE firms do (Navas-Aleman, 2011; Yao, 2012).

The effectiveness of inter-organizational learning is jointly determined by the characteristics of the knowledge provider, the knowledge receiver, and the relationship between them (Ingram, 2002). Scholars have found that the effectiveness of learning by exporting is constrained by many firm- and dyad-level factors such as the exporter's technological capabilities and absorptive capacity (Alcacer & Oxley, 2014; Li et al., 2010; Salomon & Jin, 2010; Smith, 2014), the technological sophistication of the foreign customer (Alcacer & Oxley, 2014; Salomon, 2006), and the duration, closeness, and quality of the relationship between the exporter and the foreign customer (Alcacer & Oxley, 2014; Salomon, 2006). Unfortunately, EM firms tend to be disadvantaged in all of these areas. Their technology is usually weak, they are inexperienced in international business, and they are unfamiliar partners for foreign customers involved in low-end transactions. Salomon and Jin (2010) found that technology laggards apply for fewer patents than technology leaders subsequent to exporting. Li and his colleagues have shown that Chinese firms need

to invest in R&D and advertising in order to enhance the positive relationship between exporting and innovation (Li et al., 2010). Smith found that the net effect of exporting on a firm can even be negative if it does not "…possess the necessary technological capabilities, absorptive capacity, and resources at home to utilize spillover benefits from abroad fully, or to meet demand for more advanced products abroad" (Smith, 2014: 254). While exporting creates a channel for learning from overseas, how that knowledge is applied to innovation is a complex matter. Looking into the process may help explain how some EM firms benefit more from exporting than others.

A Recombinatory View of Innovation

Starting from Schumpeter (1934), many influential scholars have viewed innovation as a new recombination of existing knowledge (Cohen & Malerba, 2001; Fleming, 2001, Henderson & Clark, 1990; Kogut & Zander, 1992, Nelson & Winter, 1982). That conceptualization considers innovation as not only a search for new knowledge, but also an effort to combine new and old components in novel ways (Fleming, 2001). Firms with multiple knowledge sources are likely to have access to more diverse inputs, and recombining it is believed to give them more potent opportunities for high-quality and more valuable innovation (Faems, de Visser, Andries & Van Looy, 2010; Wang, Chen & Chang, 2011). In addition, diverse knowledge sources encourage management to make an explicit cognitive investment in retrospective sense-making. This minimizes the risk of inappropriate generalization of knowledge acquired in each specific context, and it also stimulates more-deliberate learning in an organization (Zollo & Winter, 2002).

Access to diverse knowledge sources leads to a diverse knowledge base internally. Scholars have found that firms with more diversified knowledge portfolios tend to invest more in R&D, file more patent applications, and announce more breakthrough innovations (Garcia-Vega, 2006; Quintana-Garcia & Benavides-Velasco, 2008; Srivastava & Gnyawali, 2011). This may help to explain why firms have become increasingly active in organizing complex knowledge-seeking activities in recent years (Chesbrough, 2003; Faems et al., 2010). Suppliers, customers, competitors, universities, and others can all serve as external knowledge sources for firms (Savino, Petruzzelli & Albino, 2017). Some firms internationalize their value chain explicitly to tap into knowledge sources in different countries (Hitt, Hoskisson & Kim, 1997; Singh, 2008). Some others manage a portfolio of diverse alliance partners and/or diverse business activities in order to maintain access to diverse knowledge sources (Powell, Koput & Smith-Doerr, 1996).

Diverse external knowledge sources and a diverse internal knowledge base enlarge the pool of knowledge components that a firm may potentially apply, but they could be useless if a firm fails to integrate new knowledge with its own (Enkel & Gassman, 2010; Savino et al., 2017; Zhao & Islam, 2017). That suggests that exporters observed to be more innovative than non-exporters may achieve that superior innovation performance not only by tapping into overseas knowledge, but also by successfully combining what they learn with their local, experiential knowledge. As Corredoira and McDermott (2014) have shown, combining domestic and foreign knowledge is a key mechanism by which EM firms innovate. They found that interactions with multinational customers were most effective in improving the technological competence of Argentine auto parts suppliers when there were complementary interactions with local entities such as industry associations and the government's supporting institutions.

Institutional Development as a Resource

Institutions can be regarded as constraints devised to structure interaction among social entities (North, 1990). They are supported by normative, cognitive, and coercive pillars (Scott, 1995). They strongly influence people's behavior, and organizations' strategies and performance (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). International business scholars usually consider a society's institutions as a resource, a major determinant of transaction costs, and a common basis of difference among economies (Jackson & Deeg, 2008). These three roles of institutions tend to influence different stages of learning by exporting and innovation through recombination.

Institutions to some extent shape an economy's resource environment and thus the resources and capabilities of firms embedded in that environment (Jackson & Deeg, 2008; Spencer, 2008). When institutional arrangements isolate a market from capital, goods, or technology transfer from overseas, it tends to be very deficient in overseas knowledge. Such knowledge is rare and difficult to replace, giving it greater potential to generate sustainable competitive advantage for a firm which

can acquire it (Barney, 1991). When exporting is permitted, exporters transacting with overseas customers are more likely to be the owners of such rare knowledge, giving them an information advantage. That competitive edge gives exporters more chances than non-exporters to make novel recombinations constituting innovation.

In a market more open to trade and foreign capital, the information advantage of exporters may be offset by alternative access to overseas knowledge. Multinational enterprises (MNEs) may arrive with their products and investment. They bring overseas knowledge and may share it with their local partners or transaction counterparties. Even local firms with no direct relationship with an MNE may benefit through unintentional knowledge spillovers generated via demonstration effects and personnel mobility. In addition, all firms in a more open institutional environment have better chances to seek overseas knowledge by importing technology and capital goods, or even reaching out through investing overseas (Bertschek, 1995; Braga & Willmore, 1991; Chang & Xu, 2008; Khanna & Palepu, 2010; Luo & Tung, 2007). Conner and Prahalad have shown that such organizational solutions are often more effective than arm's length transactions in transferring tacit or complex knowledge (Conner & Prahalad, 1996).

After the market is open, exporters tend to lose their information advantage. They may no longer be able to sustain outstanding innovation performance, as a marginal increase in exporting may not bring in as much innovation advantage as before. Even if they are still very innovative, exporters may also have other access to overseas knowledge and no longer rely heavily on exporting as a major knowledge source. In an open market, exporting is just an elementary internationalization technique which may not be able to bring in rare resources for which there is no ready substitute. Its contribution to firms' innovation is thus reduced.

Compared with more advanced economies, EMs are generally less open to overseas capital and products. Within an EM, the level of market openness often varies among regions (Chin, 2010; Kafouros, Wang, Piperopoulos & Zhang, 2015; Kozhikode & Li, 2012; Pack & Saggi, 1997). Exporters' information advantage is more likely to be offset in a home region that is relatively open to global trade and investment (Chang & Xu, 2008; Zhang, Li, Li & Zhou, 2010).

Hypothesis 1: Greater openness to the global market in the home region weakens the positive relationship between exporting and innovation for emerging market firms.

Even with superior access to knowledge from abroad, exporters may not be able to properly exploit that advantage and innovate if their other knowledge sources are inadequate. The home region is, however, an alternative source of knowledge that is conveniently at hand for EM firms. Emerging economies are frequently considered as lacking advanced technology, but recent scholarship on comparative capitalism has shown that local organizations in emerging economies can be important sources of applied, experiential knowledge which is particularly relevant locally (Corredoira & McDermott, 2014). Studies have revealed that in both emerging markets and developed countries, new production capabilities are mainly developed by adapting knowledge to new contexts, combining routines and techniques from different sources (Herrigel et al., 2013; MacDuffie, 2013). Among all exporters, those with better access to home knowledge tend to have a better chance to combine it with overseas knowledge and innovate.

Countries and regions develop institutions such as innovation systems to promote local sourcing of knowledge. These institutions provide resources to local knowledge contributors, while the major knowledge contributors – typically enterprises, public research institutes, universities, etc. – may vary from country to country (Kumaraswamy, Mudambi, Saranga & Tripathy, 2012; Motohashi & Yun, 2007). For example, financial support from the government, typically through subsidy programs and tax preferences, provides basic resources for innovation and at the same time reduces the potential costs of failure (Hall & Lerner, 2010). This enables local entities to engage in innovative activities and to generate more local knowledge. Such institutional resources are especially beneficial for exporters as they help to develop a pool of technologically capable and motivated local players which can serve as alternative sources of knowledge. Exporters operating in such an environment have better access to local knowledge which they can recombine in novel ways with the knowledge they acquire through exporting. It has been shown that where local competitiveness is appropriate, foreign buyers can contribute to upgrading technology in emerging markets (Giuliani, Pietrobelli & Rabellotti, 2005).

Hypothesis 2: Institutions that support local innovation in the home region strengthen the positive relationship between exporting and innovation for emerging market firms.

Market Intermediaries and the Costs of Knowledge Recombination

The existence of multiple sources of knowledge does not guarantee that they are readily available for firms at reasonable cost. The cost of knowledge searching, contracting, and monitoring can be huge if professional market intermediaries are not well developed in a market. Transaction costs tend to discourage knowledge transactions and recombination (Williamson, 1975). In addition to providing resources, a second role of institutions in the process of innovation is to reduce the cost of knowledge transactions (Jackson & Deeg, 2008), facilitating knowledge transfer and recombination.

Compared with advanced economies, EMs typically suffer from a lack of specialized intermediaries such as brokerages, law firms, accounting firms, consulting firms, and industry associations. Such institutional voids may pervade the capital, factor, and product markets in an emerging economy (Khanna & Palepu, 2010). They make it expensive and sometimes impossible to search for potential transaction counterparties, to make contracts smoothly and efficiently, and perhaps to enforce contracts which have been signed. That situation is especially difficult when there are intangible assets such as knowledge involved in a transaction. Intermediaries are usually required to play the role of pricing, trust-building, and endorsement in such transactions. While informal institutions such as *guanxi* may sometimes replace the role of market intermediaries in EMs, they are typically less effective in facilitating transactions between unfamiliar parties (Peng, 2003). The absence of market intermediaries can be an important antecedent of market failure (Khanna & Palepu, 2000). Many EMs seek to fill such voids, but firms benefit differently from such efforts (Chittoor et al., 2015; Cuervo-Cazurra & Dau, 2009; Kim et al., 2010). For example, Dau (2013) found that in Latin America, pro-market reforms enhanced the competitiveness of internationalized firms more than that of purely domestic ones.

Effective market intermediaries might be expected to improve the innovativeness of exporters more than that of non-exporters. By facilitating the flow of knowledge, brokering between knowledge sellers and buyers, and providing complementary expertise and resources to reduce interaction costs (Kostinets, 2014; Nicholas & Shimizu, 2013), market intermediaries may significantly reduce the transaction costs involved in sourcing from multiple knowledge sources and help exporters with their adaptation and recombination efforts, such as hiring quality R&D staff, studying dynamic market conditions, adapting or further improving their products, and looking for local suppliers or financial support. That should help exporters to build on the knowledge they have acquired through exporting and that they have acquired locally to innovate.

Hypothesis 3: Better-developed market intermediaries in the home region strengthen the positive relationship between exporting and innovation for emerging market firms.

Institutional Distance and Innovation

In addition to the existence of multiple knowledge sources and efficient access to them, the dissimilarity of knowledge acquired from different sources should be another important determinant of successful recombination. This is where institutional distance between nations enters the picture, as too large a distance can make knowledge acquired in different markets too different to combine.

Knowledge tends to be localized geographically (Almeida & Kogut, 1999; Owen-Smith & Powell, 2004) and imperfectly distributed (Dicken, 2003; Hayek, 1945). Those pieces relevant to organizational practices vary from country to country since they have evolved and are being used in different institutions (Kostova, 1999). Firms exporting to different countries dealing with such diversity may have access to and absorb different types of knowledge with different levels of sophistication and differing relevance at home. Institutional distance makes the knowledge acquired in different markets less similar, less consistent, and less related with each other (Eden & Miller, 2004; Ghemawat, 2001; Kostova, 1999).

Knowledge components that are more similar to each other have a better chance of being integrated. Research on technological innovation has shown that technology coherence – the extent to which a technology portfolio consists of technologies "that partly share a common knowledge base, that rely on common scientific principles, or that have similar heuristics of search" (Leten, Belderbos & Van Looy, 2007: 570), tends to make the effect of technology diversification on innovation more

positive. Research on diversity has shown that task groups working in very different task environments tend to find little similarity in their knowledge bases, to have less to share, and to feel they have less to gain from sharing (De Dreu, 2006; Jehn, 1995). This may lead to dysfunctional conflict, hinder communication and coordination, and decrease social integration, all of which would be expected to inhibit knowledge transfer, sharing and integration within a firm (De Dreu, 2006; Harrison & Klein, 2007; Jehn, 1995; Li & Hambrick, 2005).

Firms usually find it difficult to recombine knowledge acquired from very different environments (Breschi, Lissoni & Malerba, 2003; Lane & Lubatkin, 1998; Li & Shenkar, 1996; Li & Yue, 2008; Phene, Fladmoe-Lindquist & Marsh, 2006), specifically overseas markets with very large institutional distance from their home country (Kostova, 1999). Institutional distance leads to different technical and organizational problems, calling for dissimilarity in incentive schemes and organization structures for innovation. This tends to substantially decrease the coherence between the knowledge exporters may source from destination countries and what they can source locally (Lane & Lubatkin, 1998). This is especially true for EM firms, which tend to suffer from limited international experience and weak absorptive capacity. EM firms may find it easier to identify, understand, and combine the knowledge they have acquired through exporting to destination countries with institutions more similar to those at home. It has been found, for example, that managers of EM firms are able to operate more easily in other countries with similar institutions because they "…can more easily understand and adapt to [the] poor conditions than can their developed country counterparts" (Cuervo-Cazurra & Genc, 2008). Exporting to destination countries institutionally distant from the home country may make it more difficult for exporting firms to innovate.

Hypothesis 4: Exporting to overseas markets with similar institutions promotes innovation by emerging market firms more effectively than exporting to overseas markets with very different institutions.

METHODS

Data

The substantial volume of its exports and its significant institutional fragmentation make China a suitable context for studying these issues empirically. The hypotheses were tested using archival data collected in annual censuses of industrial enterprises conducted by China's National Bureau of Statistics (NBS) between 2005 and 2007. Each year the NBS collects financial information on industrial firms in China with annual sales of at least US $600,000 (roughly, at the 2006 exchange rate) and publishes aggregated information in the official China Statistics Yearbooks. That database has been used in prior studies, including those of Buckley (Buckley, Clegg & Wang, 2002), Chang and Xu (2008), Pan (Pan, Li & Tse, 1999), and Park's group (Park, Li & Tse, 2006). The 2005–2007 data were used here mainly because some of the most important measures for this study, such as export intensity, new product output, and R&D investment, have only been available during this period.

Hypotheses 1–3 focus on the effects of exporting and home region institutional development on exporting firms' innovation performance. Testing them involved comparing the innovation performance of exporters and non-exporters. The sample used to test the first two hypotheses consisted of all manufacturing firms with two-digit China Standard Industry Classification codes from 13 to 43 covered by the census (482 four-digit SIC sectors in total), with or without export sales. Those firms whose information was incomplete were excluded. Firms which changed their primary sector during the period studied were also dropped because a change in primary sector usually means a change in the firm's primary business, or at least substantial product diversification. The complex interactions between product diversification, exporting, and innovation were beyond the scope of this study.

The yearly data were matched using unique company identifiers to assemble an unbalanced panel database. All the explanatory variables were lagged by one year in the analyses to deal with causality. This reduced the sample to those observed in 2006 and 2007. The final sample involved 253,559 firms and 431,673 firm-year observations (203,198 observations in 2006, and 228,475 in 2007). Among the observations in 2006, 69.7% of the firms said they did not export, 8.3% claimed to export part of their production, and 22.0% exported all their products in the previous year, i.e., 2005. In 2007, the three ratios were 71.2, 7.8, and 21.0%, respectively. 10.6% of the manufacturers said they introduced new products in 2006, and 9.4% claimed to have done so in 2007.

Hypothesis 4 focuses on institutional distance. The non-exporters (who of course face no institutional

distance) were excluded in that analysis. The information about export destinations is published by China's General Administration of Customs. Their database contains information about each cross-border transaction since 2001. For each transaction, the database reports whether it was importing or exporting, the first origin or final destination country of the goods, the type, quantity, unit price, and total value of the goods, and the name, location, and contact information of the Chinese firms involved.

In 2005, there were 4.8 million transactions recorded in the customs database involving 43,304 firms recorded in the NBS database, of which 38,934 firms were involved in exporting. In 2006, the corresponding figures were 6.4 million transactions involving 51,160 firms of which 45,527 firms were involved in exporting. Combining the customs database and NBS databases yielded a two-year panel of data where the explanatory variables were measured in 2005 and 2006 and the dependent variables were measured in 2006 and 2007. After dropping the observations without any exporting to EMs or AEs and those with incomplete information, the final sample had 78,790 firm-year observations, among which 36,286 exported in 2005 and 42,504 exported in 2006.

Measures

Dependent variable

Based on the NBS' definition, new products are those that are new to the market with either a completely new design, new technology or based on a new scientific principle, or which offer a significant improvement over existing products. Patented new products considered internationally competitive are given priority for certification as being new, which brings various tax and regulatory advantages (Li et al., 2010; Zhou & Li, 2008). So firms have no incentive to hide their new product output. Previous research has used similar definitions (e.g., Laursen & Salter, 2006).

Product innovation was quantified as the value of a firm's new product output each year. To reduce the skew in this variable, a logarithmic transformation was applied. So $new\ product\ output_t = \ln$ (1 + the value of new product output in year t).

Explanatory variables

$Export\ intensity_{t-1}$ was calculated by dividing export sales in year $t - 1$ by total sales in the same year. A logarithmic transformation was again applied to allow for the possibility of non-linearity and to allow the coefficient to be interpreted as elasticity.

As in other EMs, institutional development in China varies widely from place to place (Kwon, 2012; Lu & Ma, 2008). Some regions have much better-developed institutions than others (Peng, 2003; Shi, Sun, Pinkham & Peng, 2014). Market openness, support for innovation, and development of market intermediaries were thus measured on the provincial level. Market openness is the extent to which goods and capital can flow freely across a market's boundaries (Finger, 2011). Since the late 1970s, China has started to open its markets to the rest of the world step by step. The open-door policy was first introduced in the four special economic zones in Shenzhen, Zhuhai, Shantou, and Xiamen in 1980. The policy loosened restrictions on international business, providing incentives for international trade and the cross-border flow of capital, technology, and equipment. In 1983, the policy was extended to Hainan province and fourteen coastal cities. Later more and more areas came to be covered, such as the Yangtze River delta, the Pearl River delta, and the Liaodong and Shandong peninsulas. Numerous economic development zones were set up (Liou, 2012). The number of special economic zones, coastal cities, and national economic development zones in each province in 2005 and 2006 was used to quantify the level of market openness of the different provinces. The counts were expressed as the variable $regional\ market\ openness_{t-1}$.

Previous research on innovation systems has usually used the volume and the composition of R&D investments to represent the support for innovation provided by local institutions (e.g., Motohashi & Yun, 2007). In this research, the R&D investments made by the government in each province in year $t - 1$ were used to represent institutional support for innovation as well as the local knowledge supply. The information was collected from the China Statistical Yearbooks on Science and Technology for 2006 and 2007 (National Bureau of Statistics & Ministry of Science and Technology, 2006, 2007). To account for the inter-provincial differences in industry composition, the number of employees hired by high-tech industries in the development zones of each province in year $t - 1$ was used to represent the scale of high-tech industry. The data came from the NBS. Government's investment in R&D was divided by the number hired to evaluate the variable $regional\ R\&D\ funding_{t-1}$. The unit of this variable is RMB ten thousand.

The development of market intermediaries in each province was quantified with one of the sub-indices of the marketization index developed by

Fan, Wang, and Zhu (2010). They developed a province-based index evaluated annually since 2003 designed to capture regional differences in the development of market-supporting institutions. Their composite index is constituted from information in five categories: (1) government and market forces; (2) development of enterprises which are not state-owned; (3) development of commodity markets; (4) development of factor markets; and (5) development of market intermediaries and the legal environment. One sub-index of the fifth category describes the development of market intermediaries such as consulting firms, accounting firms, law firms, and industry associations in each province. The variable was named *regional intermediary development*$_{t-1}$. A larger value indicates better development of market intermediaries.

China was considered an EM in light of its prevalent institutional voids (Khanna & Palepu, 2010). China's level of institutional development was treated as similar to that of economies considered EMs by the International Monetary Fund. The variable *EM vs AE export intensity*$_{t-1}$ was defined to represent a Chinese firm's exporting to EM versus AE economies. It was defined as the value of products exported to other EMs in each year as a proportion of the firm's total exports to all AEs and other EMs. The list of EMs and AEs in 2007 was that of the International Monetary Fund in 2005 and 2006. In fact, only 1.48% of China's exports by value during the period studied went to the least developed countries as identified by the United Nations. Chinese firms that only exported to such countries were excluded from the analysis.

Control variables

Market openness introduces not only foreign knowledge but also foreign competition into the home region. Market competition has been shown to influence firms' product innovation strategies (Aghion, Bloom, Blundell, Griffith & Howitt, 2005). To partial out such effects, a Hirschman–Herfindhal index (HHI) was used to represent *sector market concentration*$_{t-1}$. For each firm i in industry k,

$$\mathrm{HHI}_{ikt-1} = \sum_{i=1}^{n_{kt-1}} \left(\mathrm{sales}_{ikt-1} \Big/ \sum\nolimits_{j=1}^{n_{kt-1}} \mathrm{sales}_{jkt-1} \right)^2.$$

It is generally believed that highly concentrated industries are limited in competition (e.g., Chen, 2008; Li, 2008; Li et al., 2010). Knowledge diversity has been found to be more beneficial when the market is more competitive (Pitcher & Smith, 2001). The potential moderating effects of market competition were therefore considered by including the interaction between export intensity and market competition in the models as *export intensity*$_{t-1}$ × *sector market concentration*$_{t-1}$.

Intellectual property (IP) protection tends to encourage innovation by protecting the hoped-for returns (Khanna & Palepu, 2010; Zhang et al., 2007). To take this effect into account, *regional IP protection*$_{t-1}$ was measured using the number of IP lawsuits closed divided by the number of IP lawsuits filed in each province in year $t - 1$. The information came from the China Yearbooks on Intellectual Property for 2006 and 2007.

Most empirical studies have measured capacity for absorbing technology in terms of prior related knowledge, and a majority have operationalized it using R&D expenditures (for a review, see Volberda, Foss & Lyles, 2010). Following that lead, *tech absorptive capacity*$_{t-1}$ was a firm's R&D expenditures in year $t - 1$ as a proportion of its sales in that year and multiplied by 100. A logarithmic transformation was then applied to allow for the possibility of non-linearity. To control for any potential influence of absorptive capacity on the effectiveness of learning by exporting, a term representing the interaction between *export intensity*$_{t-1}$ and *tech absorptive capacity*$_{t-1}$ was also included in the regressions.

There has been some debate over the impact of firm size on innovation. Schumpeterian economists suggest a positive relationship, as larger firms can hedge the risks of R&D by pursuing diverse projects (Braga & Willmore, 1991; Sasidharan & Kathuria, 2011). Organization scholars have, however, contended that larger firms tend to be less innovative as they are less affected by market competition (Kathuria, 2008). Previous research has found mixed empirical evidence, most of which suggests a non-linear relationship (Kumar & Aggarwal, 2005; Kumar & Saqib, 1996; Siddharthan, 1988). We used RMB 10 million as the unit for the variable *firm size*$_{t-1}$. Following the lead of previous research (Li et al., 2010), the natural logarithm of a firm's sales in year $t - 1$ was used as a measure of firm size to take any potential non-linearity into account.

The impact of a firm's age on its innovation performance is also not clear. With rich complementary assets accumulated over years, older firms are more likely to make money from any R&D investment and so may be more motivated to

innovate (Iansiti, 2000; Sasidharan & Kathuria, 2011). However, older firms are also more likely to suffer from organizational inertia, which makes it difficult for them to adapt their resources, processes, and strategies to new technologies or products (Dougherty & Hardy, 1996; Hannan & Freeman, 1984). In any case, *firm age*$_{t-1}$, calculated by subtracting a firm's setup year from year $t - 1$, was one of the variables included in the analyses.

Organizational slack is also likely to influence a firm's innovation in different ways (Cyert & March, 1963). It on the one hand enables a firm to invest in long-term R&D projects, and on the other hand may either diminish innovation incentives or encourage high-risk projects (Nohria & Gulati, 1996). Previous research has found mixed evidence about the impact of organizational slack on firms' innovation (Greve, 2003; Rosner, 1968). In this study, the sector averages were deducted from each firm's gross profit ratio and asset–liability ratio to create two operational measures of slack for each firm: *adjusted asset–liability ratio*$_{t-1}$ and *adjusted gross profit ratio*$_{t-1}$. Higher ratios indicate more organizational slack.

Foreign-invested firms may prefer concentrating their R&D activities at home or in advanced economies (Braga & Willmore, 1991; Kathuria, 2008). State ownership may burden a firm with complex non-economic objectives. Such ownership effects were taken into account by including *foreign ownership*$_{t-1}$ and *state ownership*$_{t-1}$ percentages for each firm in the analyses. To control for any fixed year or industry effects, 31 two-digit industry dummies and a year dummy representing 2007 were also included in the models.

Two additional control variables were included in the models testing hypothesis 4. The first was *OEM export intensity*$_{t-1}$. It was calculated as the value of products manufactured under contract for other brands and exported (OEM products) as a proportion of the firm's total export value in each year. Many scholars have found that overseas buyers dominate in OEM relationships and that they keep Chinese manufacturers away from innovative technology to avoid creating potential competitors (Kang, 2011; Zhang, Liu & Zheng, 2008). The second control variable that was included in the models testing hypothesis 4 was *market variety*$_{t-1}$, measured as the number of overseas countries to which an exporter sold products in year $t - 1$. Exporting to many different countries may encourage a firm to work on product adaptation and to introduce new products. The data source for both of these additional control variables was the customs database.

Analytical Methods

Following the lead of previous empirical studies with panel data (Bertschek, 1995; Kumar & Aggarwal, 2005), generalized linear regression (GLS) models were evaluated in the analyses. Random-effects regression was used so that the industry dummies, which did not vary from year to year, would not be dropped from the regressions. To reduce any multicollinearity among the explanatory variables, all of the variables involved in interaction terms were mean-centered.

Research on firm-specific advantages suggests that a firm's intangible capabilities such as innovativeness may be the driver for rather than a result of the firm's internationalization (Cassiman & Golovko, 2011; Delios & Beamish, 1999; Rodriguez-Duarte, Sandulli, Minguela-Rata & Lopz-Sanchez, 2007; Salomon & Shaver, 2005). If so, models like these may suffer from reverse causality problems. In addition, there may be some unobserved firm characteristics determining both exporting and innovation simultaneously, leading to endogeneity problems (Melitz & Costantini, 2007). To deal with this possibility, the *export intensity*$_{t-1}$ variable was instrumented with a first-stage random-effects linear model and the predicted values were used in the second-stage innovation regressions (Golovko & Valentini, 2014). Following Chittoor's lead (Chittoor et al., 2015), sector-level export intensity was used as the instrument for firm-level export intensity. Similarly, *EM vs AE export intensity*$_{t-1}$ and *market variety*$_{t-1}$ were instrumented with the respective industry-level variables. In addition, all of the explanatory variables were lagged by one year, and the lagged dependent variable, *new product output*$_{t-1}$, was also included in the models. This allowed for a dynamic component in any firm-specific effects, reducing the potential for serial correlation of the errors while controlling for any endogeneity of exporting (Greene, 2003). Wooldridge (2005) has described such a procedure as a way to address endogeneity concerns in panel data analysis. Chittoor and his coauthors (Chittoor et al., 2015), Cassiman and Golovko (2011), and Salomon and Jin (2008) used similar methods in their research.

RESULTS

Table 1 presents descriptive statistics and a correlation matrix describing the key variables and their inter-relationships. The unit of *new product output*$_t$ and *new product output*$_{t-1}$ was RMB 10 million in Table 1. Since there were some high correlations between explanatory variables, variance inflation factors (VIFs) were calculated to test for multicollinearity. The mean VIF obtained in the full model was around 1.43, and the maximum VIF was 2.37. Both are substantially below 10, which is suggested as the rule-of-thumb cutoff (Ryan, 1997), minimizing multicollinearity concerns. To save space, the first-stage regression results are not reported.

Table 2 reports the results of the second-stage random-effects GLS regressions. All of the models included the control variables. The interaction terms were added sequentially. Model 1 is the baseline model with the control variables only. Model 2 tests hypothesis 1, and model 3 tests hypothesis 2. Model 4 tests hypothesis 3. Model 5 is the complete model testing hypotheses 1–3. The significance level of the Wald Chi-squared statistics in all of the models indicates that the explanatory variables explained a significant portion of the variation in the dependent variable. The significance of the coefficients of the explanatory variables supports the hypotheses.

Hypothesis 1 predicts that firms operating in more open environments tend to enjoy less information advantage from exporting. The coefficient of the term representing the interaction of *export intensity*$_{t-1}$ with *regional market openness*$_{t-1}$ was negative and significant ($p \leq 0.001$ in models 2 and 5). Hypothesis 1 was thus strongly supported.

Hypothesis 2 expects that institutions in the home region which support innovation can strengthen the positive relationship between exporting and innovation. The coefficient of the term representing the interaction of *export intensity*$_{t-1}$ with *regional R&D funding*$_{t-1}$ was significant and positive ($p \leq 0.001$ in models 3 and 5). This delivers support for hypothesis 2.

Hypothesis 3 predicts a positive moderating effect of *regional intermediary development*$_{t-1}$ on the relationship between *export intensity*$_{t-1}$ and *new product output*$_t$. The coefficient of the term representing the interaction of *export intensity*$_{t-1}$ with *regional intermediary development*$_{t-1}$ was significant and positive ($p \leq 0.001$ in model 4, $p \leq 0.01$ in model 5). Hypothesis 3 is therefore supported as well.

The main effect relating *export intensity*$_{t-1}$ with product innovation was significant and positive ($p \leq 0.001$ in all models). In addition to its negative moderating effect, *regional market openness*$_{t-1}$ showed a significant and positive direct relationship with innovation ($p \leq 0.001$ in models 2 and 5). This is consistent with the previous findings of research on cross-border knowledge spillovers, which has found that trade and inward FDI promote better performance within an industry but also promote competition in the neighborhood (Bansant & Fikkert, 1996; Chang & Xu, 2008; Edwards, 1993). The direct effects of *regional R&D funding*$_{t-1}$ were significant and positive ($p \leq 0.001$ in models 3 and 5). The direct effect of *regional intermediary development*$_{t-1}$ was significant and positive in model 4 ($p \leq 0.01$). The direct effect of *sector market concentration*$_{t-1}$ was significant and positive ($p \leq 0.05$ in models 1, 3 and 4), consistent with Turner's arguments (Turner, Mitchell & Bettis, 2010). The interaction between *export intensity*$_{t-1}$ and *sector market concentration*$_{t-1}$ was not significant in any of the models. As expected, *regional IP protection*$_{t-1}$ showed a significant and positive relationship with product innovation ($p \leq 0.001$ in all models). *Tech absorptive capacity*$_{t-1}$ and its interaction with *export intensity*$_{t-1}$ both showed significant and positive relationships ($p \leq 0.001$ in all models). For absorptive capacity, that is not surprising. A firm with good absorptive capacity should be good at learning in general, including learning from exporting. The positive moderating effect of absorptive capacity delivers support for previous findings about learning through exporting which has shown that absorptive capacity increases its effectiveness (e.g., Li et al., 2010).

The effects of *firm size*$_{t-1}$ and *firm age*$_{t-1}$ were both positive ($p \leq 0.001$ in all models). This indicates that larger and older manufacturers are more innovative in the empirical context of this study. The two measures of organizational slack showed no consistent effect. *Foreign ownership*$_{t-1}$ has a significant negative effect ($p \leq 0.001$ in models 1–4, $p \leq 0.01$ in model 5), which indicates that exporting foreign investors were not as interested in introducing new products as their local competitors. This finding is consistent with those of previous studies (Fan & Hu, 2007; Kathuria, 2008). The effect of *state ownership*$_{t-1}$ turned significant and positive after the institutional variables were included ($p \leq 0.01$ in model 2, $p \leq 0.001$ in models 3 and 5). This is surprising and deserves more

Table 1 Descriptive statistics and correlation matrix

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. New product output$_t$	1.50	44.21															
2. Export intensity$_{t-1}$	0.18	0.34	0.01*														
3. Sector export intensity$_{t-1}$	0.18	0.17	0.00	0.50*													
4. Regional market openness$_{t-1}$	5.23	2.69	−0.01*	0.26*	0.28*												
5. Regional R&D funding$_{t-1}$	2.64	2.07	0.00	0.04*	0.04*	−0.07*											
6. Regional intermediary development$_{t-1}$	4.70	2.52	0.01*	0.06*	0.06*	0.14*	0.29*										
7. Sector market concentration$_{t-1}$	0.02	0.06	0.01*	−0.04*	−0.07*	−0.02*	−0.01*	0.03*									
8. Regional IP protection$_{t-1}$	0.86	0.16	0.00*	−0.01*	−0.03*	−0.08*	0.18*	−0.02*	0.00								
9. Tech absorptive capacity$_{t-1}$	0.39	121.95	0.00	0.00	0.00	0.00*	0.00	0.00	0.00	0.00							
10. Firm size$_{t-1}$	9.64	83.08	0.61*	0.02*	−0.02*	0.00*	−0.01*	0.01*	0.02*	0.00	0.00						
11. Firm age$_{t-1}$	8.24	9.34	0.03*	−0.03*	−0.08*	−0.08*	0.00	0.00	0.02*	0.01*	0.00	0.06*					
12. Adjusted asset–liability ratio $_{t-1}$	0.00	0.30	0.00	0.00	0.00	0.03*	0.05*	0.03*	0.00	0.01*	0.00	0.00	0.10*				
13. Adjusted gross profit ratio$_{t-1}$	0.00	11.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.01*	0.10*	0.00	−0.01*	−0.01*			
14. Foreign ownership$_{t-1}$	0.17	0.35	0.01*	0.41*	0.25*	0.22*	−0.09*	0.11*	0.00*	−0.04*	0.00	0.04*	−0.07*	−0.09*	0.00		
15. State ownership$_{t-1}$	0.04	0.18	0.03*	−0.07*	−0.09*	−0.15*	−0.03*	−0.05*	0.02*	0.01*	0.01*	0.05*	0.33*	0.09*	−0.01*	−0.08*	
16. New product output$_{t-1}$	1.18	37.11	0.74*	0.01*	0.00	−0.01*	0.00	0.01*	0.01*	0.00*	0.00	0.64*	0.03*	0.00	0.00	0.01*	0.02*

Notes: $N = 431{,}673$.

* Indicates a correlation significant at the $p \leq 0.05$ level of confidence.

Table 2 Coefficients of second-stage random-effects GLS regressions predicting new product output (H1–H3)

	Model 1	Model 2	Model 3	Model 4	Model 5
H1: export intensity$_{t-1}$ × regional market openness$_{t-1}$		−0.07*** (0.01)			−0.08*** (0.01)
H2: export intensity$_{t-1}$ × regional R&D funding$_{t-1}$			0.06*** (0.01)		0.05*** (0.01)
H3: export intensity$_{t-1}$ × regional intermediary development$_{t-1}$				0.04*** (0.01)	0.03** (0.01)
Export intensity$_{t-1}$	0.22*** (0.02)	0.20*** (0.02)	0.19*** (0.02)	0.22*** (0.02)	0.16*** (0.02)
Regional market openness$_{t-1}$		0.03*** (0.00)			0.06*** (0.00)
Regional R&D funding$_{t-1}$			0.20*** (0.00)		0.24*** (0.00)
Regional intermediary development$_{t-1}$				0.01** (0.00)	−0.13*** (0.01)
Sector market concentration$_{t-1}$	0.02* (0.01)	0.01†(0.01)	0.01* (0.01)	0.02* (0.01)	0.01†(0.01)
Export intensity$_{t-1}$ × sector market concentration$_{t-1}$	0.03 (0.03)	0.02 (0.03)	0.02 (0.03)	0.03 (0.03)	0.02 (0.03)
Regional IP protection$_{t-1}$	0.18*** (0.00)	0.19*** (0.00)	0.15*** (0.00)	0.18*** (0.00)	0.15*** (0.00)
Tech absorptive capacity$_{t-1}$	0.34*** (0.00)	0.33*** (0.00)	0.34*** (0.00)	0.34*** (0.00)	0.33*** (0.00)
Export intensity$_{t-1}$ × tech absorptive capacity$_{t-1}$	0.05*** (0.01)	0.05*** (0.01)	0.04*** (0.01)	0.05*** (0.01)	0.05*** (0.01)
Firm size$_{t-1}$	0.11*** (0.00)	0.10*** (0.00)	0.12*** (0.00)	0.12*** (0.00)	0.11*** (0.00)
Firm age$_{t-1}$	0.05*** (0.00)	0.04*** (0.00)	0.05*** (0.00)	0.05*** (0.00)	0.05*** (0.00)
Adjusted asset–liability ratio$_{t-1}$	−0.00 (0.00)	−0.00 (0.00)	−0.01*** (0.00)	−0.00 (0.00)	−0.01* (0.00)
Adjusted gross profit ratio$_{t-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Foreign ownership$_{t-1}$	−0.08*** (0.01)	−0.07*** (0.01)	−0.05*** (0.01)	−0.09*** (0.01)	−0.02** (0.01)
State ownership$_{t-1}$	0.01†(0.00)	0.01** (0.00)	0.01*** (0.00)	0.01†(0.00)	0.02*** (0.00)
New product output$_{t-1}$	1.65*** (0.01)	1.77*** (0.01)	1.66*** (0.00)	1.64*** (0.01)	1.76*** (0.00)
Constant	0.82*** (0.01)	0.85*** (0.01)	0.87*** (0.01)	0.83*** (0.02)	0.80*** (0.01)
Wald's Chi squared	323,782***	396,354***	343,716***	316,579***	406,766***

Notes: Standardized coefficients are reported.
Mean VIF of Model 5 = 1.43.
Industry dummies and year dummy were included in all models.
All interaction terms were standardized in all models. Standard errors are in parentheses.
† Indicates significance at the $p \leq 0.10$ (* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$) level of confidence (two-tailed test).

Table 3 Descriptive statistics and correlation matrix of the exporting sample

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. New product output$_t$	3.51	66.34																
2. EM vs AE export intensity$_{t-1}$	0.24	0.34	0.01*															
3. Sector EM vs AE export intensity$_{t-1}$	0.24	0.12	0.04*	0.35*														
4. Tech absorptive capacity$_{t-1}$	0.26	2.01	0.03*	0.03*	0.04*													
5. OEM export intensity$_{t-1}$	0.28	0.41	0.01*	−0.25*	−0.15*	−0.04*												
6. Market variety$_{t-1}$	8.61	10.42	0.07*	0.16*	0.09*	0.02*	0.01											
7. Export intensity$_{t-1}$	51.17	41.06	−0.03*	−0.18*	−0.24*	−0.07*	0.29*	0.18*										
8. Regional market openness$_{t-1}$	6.15	2.33	−0.02*	−0.06*	−0.06*	−0.06*	0.26*	0.07*	0.22*									
9. Regional R&D funding$_{t-1}$	2.72	2.18	0.00	0.14*	0.09*	0.03*	−0.28*	0.10*	0.02*	−0.14*								
10. Regional intermediary development$_{t-1}$	5.12	2.57	0.01*	−0.02*	0.00	0.03*	0.01*	0.02*	−0.01	0.00	0.32*							
11. Sector market concentration$_{t-1}$	0.02	0.05	0.02*	0.03*	0.08*	0.03*	−0.01*	0.03*	−0.07*	−0.04*	−0.02*	0.03*						
12. Regional IP protection$_{t-1}$	0.86	0.15	0.01*	0.01*	0.01*	0.01*	−0.02*	0.00	0.00	−0.12*	0.16*	0.02*	0.01					
13. Firm size$_{t-1}$	17.35	130.92	0.61*	0.01*	0.04*	0.02*	0.04*	0.12*	−0.04*	−0.02*	−0.02*	0.01	0.04*	0.00				
14. Firm age$_{t-1}$	8.50	13.07	0.03*	0.03*	0.06*	0.03*	0.00	0.03*	−0.05*	−0.05*	−0.02*	0.00	0.01*	0.00	0.05*			
15. Foreign ownership$_{t-1}$	0.46	0.45	−0.01*	−0.26*	−0.17*	−0.06*	0.45*	−0.04*	0.25*	0.20*	−0.19*	0.09*	−0.02*	−0.05*	0.00	−0.08*		
16. State ownership$_{t-1}$	0.02	0.13	0.04*	0.04*	0.07*	0.05*	−0.05*	0.00	−0.10*	−0.16*	−0.03*	−0.05*	0.03*	0.03*	0.08*	0.16*	−0.13*	
17. New product output$_{t-1}$	2.87	62.82	0.51*	0.01	0.03*	0.02*	0.02*	0.06*	−0.02*	−0.02*	0.00	0.02*	0.02*	0.01*	0.68*	0.02*	0.00	0.03*

Notes: N = 78,790.

* Indicates correlation significant at the $p \leq 0.05$ level of confidence.

The summary statistics for the adjusted asset–liability ratio$_{t-1}$ and adjusted gross profit ratio$_{t-1}$ are not reported due to limited space and their lack of significance in regression models.

Table 4 Coefficients of second-stage random-effects GLS regressions predicting new product output (H4)

	Model 6	Model 7	Model S1	Model S2
H4: EM vs AE export intensity$_{t-1}$		0.11* (0.05)	0.11* (0.05)	
EM vs AE export intensity$_{t-1}$ × Tech absorptive capacity$_{t-1}$			0.09** (0.03)	
Institutional distance$_{t-1}$				−0.04* (0.02)
Export intensity$_{t-1}$ × regional market openness$_{t-1}$	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)
Export intensity$_{t-1}$ × regional R&D funding$_{t-1}$	0.05* (0.03)	0.06* (0.03)	0.06* (0.03)	0.05* (0.03)
Export intensity$_{t-1}$ × regional intermediary development$_{t-1}$	−0.07 (0.05)	−0.08 (0.05)	−0.08 (0.05)	−0.06 (0.05)
Export intensity$_{t-1}$	0.03** (0.01)	0.03* (0.01)	0.03* (0.01)	0.04** (0.01)
Regional market openness$_{t-1}$	−0.01 (0.01)	0.02* (0.01)	0.02* (0.01)	−0.01 (0.01)
Regional R&D funding$_{t-1}$	0.36*** (0.01)	0.31*** (0.01)	0.31*** (0.01)	0.36*** (0.02)
Regional intermediary development$_{t-1}$	−0.18*** (0.02)	−0.18*** (0.01)	−0.18*** (0.01)	−0.17*** (0.02)
Sector market concentration$_{t-1}$	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Export intensity$_{t-1}$ × sector market concentration$_{t-1}$	−0.01 (0.01)	−0.00 (0.01)	−0.00 (0.01)	−0.01 (0.01)
Regional IP protection$_{t-1}$	0.10*** (0.01)	0.12*** (0.01)	0.12*** (0.01)	0.10*** (0.01)
Tech absorptive capacity$_{t-1}$	0.39*** (0.01)	0.34*** (0.01)	0.31*** (0.01)	0.39*** (0.01)
Export intensity$_{t-1}$ × tech absorptive capacity$_{t-1}$	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)
OEM export intensity$_{t-1}$	−0.00 (0.01)	0.03†(0.01)	0.02 (0.01)	0.01 (0.01)
Market variety$_{t-1}$	0.22*** (0.05)	0.11* (0.04)	0.11* (0.04)	0.20*** (0.05)
Firm size$_{t-1}$	0.44*** (0.02)	0.37*** (0.02)	0.37*** (0.02)	0.44*** (0.02)
Firm age$_{t-1}$	0.06*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.06*** (0.01)
Foreign ownership$_{t-1}$	−0.15*** (0.01)	−0.10*** (0.01)	−0.10*** (0.01)	−0.14*** (0.01)
State ownership$_{t-1}$	0.09*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.09*** (0.01)
Adjusted asset–liability ratio$_{t-1}$	−0.02 (0.01)	−0.01 (0.01)	−0.01 (0.01)	−0.01 (0.01)
Adjusted gross profit ratio$_{t-1}$	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
New product output$_{t-1}$	1.86*** (0.01)	2.35*** (0.01)	2.35*** (0.01)	1.86*** (0.01)
Constant	1.14*** (0.06)	1.23*** (0.05)	1.22*** (0.05)	1.16*** (0.06)
Wald's Chi squared	55,239***	94,803***	94,788***	55,184***

Notes: $N = 78{,}790$.
Standardized coefficients are reported.
Standard errors are in parentheses.
Mean VIF of Model S1 = 1.54.
All interaction terms were centered in all models.
† Indicates significance at the $p \leq 0.10$ (* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$) level of confidence (two-tailed test).

research in the future. The significance of the positive effect of the dependent variable *new product output*$_{t-1}$ lagged by one year indicates strong persistence in innovative activities ($p \leq 0.001$ in all models).

Table 3 presents descriptive statistics and a correlation matrix for the key variables used to test hypothesis 4. Again, the unit of *new product output*$_t$ and *new product output*$_{t-1}$ was RMB 10 million in Table 3. The maximum VIF was 3.09, and the mean VIF of the full model was approximately 1.54. Multicollinearity again should not have been a major issue in the analyses.

Table 4 reports the results of the second-stage random-effects GLS regressions. The control variables were included in all of the models, and the independent variables and interaction terms were added sequentially. Model 6 is the baseline formulation. Model 7 tests hypothesis 4. The Wald Chi-squared statistics were again highly significant.

Hypothesis 4 predicts a positive relationship between *EM vs AE export intensity*$_{t-1}$ and *new product output*$_t$. The coefficient of the *EM vs AE export intensity*$_{t-1}$ term was significant and positive ($p \leq 0.05$ in model 7), as predicted. Most of the effects of the control variables remained the same as in models 1–4, with two exceptions. *OEM export intensity*$_{t-1}$ was not included in models 1–4. Surprisingly, OEM business does not seem to impede Chinese exporters' innovation, as no significant effect was detected. *Market variety*$_{t-1}$ showed a significant and positive relationship with innovation ($p \leq 0.001$ in model 6, $p \leq 0.05$ in model 7), consistent with expectations.

Supplementary Analyses

Some additional analyses were conducted to investigate which aspects of distance actually make EM exporters exporting more to other EMs more innovative than those exporting more to AEs. Institutional distance is a multidimensional concept. The institutional dimensions that are especially relevant to this research context are major candidates. Since superior technological capabilities and market knowledge have been found to constitute competitive advantages in product innovation (Atuhene-Gima & Ko, 2001), the effects of distances in technology or market demand are examined.

If it is the distance in technological sophistication between AEs and EMs that matters, strong absorptive capacity for technology might help EM exporters to overcome the difficulties created by such mismatches. If EM exporters with absorptive capacity for technology which is better than that of their peers manage to innovate more by exporting to AEs, the recombinatory advantage of exporting to other EMs proposed in hypothesis 4 might be weakened. This predicts a negative moderating effect of *tech absorptive capacity*$_{t-1}$ on the relationship between *EM vs AE export intensity*$_{t-1}$ and *new product output*$_t$. However, the coefficient of the term representing the interaction of *EM vs AE export intensity*$_{t-1}$ with *tech absorptive capacity*$_{t-1}$ was significant but positive ($p \leq 0.01$ in model S1, Table 4). This indicates that absorptive capacity for technology strengthens Chinese exporters' learning from exporting to EMs more than exporting to AEs. That is to say, absorptive capacity for technology alone does not make EM firms learn more effectively from AEs than from other EMs. In addition to technology gaps, is there perhaps a role for other dimensions of distance in explaining why EM firms learn more effectively by exporting to other EMs?

In addition to distance in technological knowledge, distance in market demand could be another major antecedent that makes knowledge acquired overseas less relevant at home. Market demand is mainly shaped by the economic development and culture of a nation. The level of global connectedness is also likely to play a role as isolated nations are more likely to be idiosyncratic. We adopted the measure of economic distance, cultural distance, and distance in global connectedness together with knowledge distance, all developed by Berry, Guillén, and Zhou (2010). For each firm i exporting to n_{it-1} different countries in year $t-1$,

$$\begin{aligned} \textit{Economic distance}_{it-1} = & \sum_{k=1}^{n_{it-1}} \textit{Economic distance}_{kt-1} \\ & \times \textit{Exporting sales}_{ikt-1} / \\ & \sum_{k=1}^{n_{it-1}} \textit{Exporting sales}_{ikt-1} \end{aligned}$$

$$\begin{aligned} \textit{Cultural distance}_{it-1} = & \sum_{k=1}^{n_{it-1}} \textit{Cultural distance}_{kt-1} \\ & \times \textit{Exporting sales}_{ikt-1} / \\ & \sum_{k=1}^{n_{it-1}} \textit{Exporting sales}_{ikt-1} \end{aligned}$$

$$Knowledge\ distance_{it-1} = \sum_{k=1}^{n_{it-1}} Knowledge\ distance_{kt-1} \times Exporting\ sales_{ikt-1} / \sum_{k=1}^{n_{it-1}} Exporting\ sales_{ikt-1}$$

$$Distance\ in\ global\ connectedness_{it-1} = \sum_{k=1}^{n_{it-1}} Distance\ in\ global\ connectedness_{kt-1} \times Exporting\ sales_{ikt-1} / \sum_{k=1}^{n_{it-1}} Exporting\ sales_{ikt-1}$$

Economic/Cultural/Knowledge distance$_{kt-1}$ represents the economic/cultural/knowledge distance between country k and China in year $t-1$. *Distance in global connectedness*$_{kt-1}$ represents the distance in global connectedness between country k and China in year $t-1$. These dimensions of institutional distances were standardized and summed up to constitute a composite variable, i.e., *institutional distance*$_{t-1}$. The correlation between *institutional distance*$_{t-1}$ and *EM vs AE export intensity*$_{t-1}$ is −0.62. Model S2 was used to examine the effect of *institutional distance*$_{t-1}$. To deal with any endogeneity concerns, the sector average distance in each dimension was used as an instrument. Consistent with the earlier arguments, the coefficient of *institutional distance*$_{t-1}$ has a significant and negative relationship with Chinese exporters' innovation ($p \leq 0.05$ in model S2, Table 4). A more detailed analysis with four individual dimensions separately in the models showed that among the four dimensions, the negative effect of cultural distance ($p \leq 0.05$) and that of distance in global connectedness ($p \leq 0.01$) were especially significant. The negative effect of knowledge was only marginal, while the effect of economic distance was not significant. The results indicate that Chinese exporters may find it especially difficult to become more innovative by exporting to overseas markets with a very different culture or degree of global connectedness.

Robustness Check

Several robustness checks examined whether the regression results were sensitive to the choice of specific operational measures. Four alternative operational measures for market openness were constructed following the lead of previous researchers (Fan et al., 2010; Kafouros et al., 2015). Annual output was used to weight the foreign equity invested in each province in year $t-1$, and the result was interpreted as quantifying *regional FDI intensity* $_{t-1}$. *Sector FDI intensity*$_{t-1}$ was similarly calculated for each four-digit sector based on each firm's Chinese Standard Industry Classification in year $t-1$. The trading data are not available by four-digit SIC in the China Customs Statistics Yearbook, so *sector trade intensity*$_{t-1}$ was quantified using the total value of exports and imports divided by the total output of each two-digit SCI sector in year $t-1$. *Regional trade intensity*$_{t-1}$ was also calculated similarly for each province. The interaction of *export intensity*$_{t-1}$ with these alternative measures showed significant and negative relationships ($p \leq 0.001$) with new product sales similar to that of *regional market openness*$_{t-1}$. The inclusion of these alternative explanatory variables did not change the support for hypothesis 4.

Comparing the results reported in Tables 2 and 4 shows that the moderating effects of market openness, support for innovation, and intermediary development are not very significant when the sample is limited to exporters. This may indicate a large difference between exporters and non-exporters. A dummy variable *export status*$_{t-1}$ was therefore created to distinguish the two groups of firms. *Export status*$_{t-1}$ equaled 1 if a firm sold to overseas markets, and 0 otherwise. The regressions were then re-evaluated with *export status*$_{t-1}$ replacing *export intensity*$_{t-1}$. Hypotheses 1–3 were still supported.

New product intensity$_t$ was tested as an alternative dependent variable to replace *new product output*$_t$. It was calculated as *new product intensity*$_t$ = ln (1 + value of annual new product output$_t$/value of annual output$_t$). Although the correlation between *new product intensity*$_t$ and *new product output*$_t$ was only 0.14 in the full sample and 0.17 in exporting sample, all of the hypotheses were still strongly supported. The detailed results of the robustness checks are available on request.

DISCUSSION AND CONCLUSION

Nations deemed EMs are dreaming of "catching up." Previous experience (especially that of Germany, Japan, and the Asian tigers) shows that successful catch-up involves both firms which can serve as important drivers of economic development (Teece, 2000) and indigenous innovation as an important step on the development ladder (Hobday, 1995). Firm-level innovation is thus

crucial, and it deserves academic attention. Although there is still some debate, two main requirements for catching up are generally recognized: (1) transferring advanced technology from overseas in order to skip costly and risky R&D; and (2) undertaking "…necessary changes [in institutional arrangements] at the new and radically enlarged scale that modern technology require[s]" (Fagerberg & Godinho, 2005: 4).

Compared with non-exporting EM firms, EM exporters have an advantage in information arbitrage. Unfortunately, though some EM exporters are very competitive in international markets, many others still remain behind the leaders, with poor innovation performance (Hobday, 1995; Li & Kozhikode, 2009; Navas-Aleman, 2011; Yao, 2012). What limits the innovation of EM exporters? The examination of hypotheses 1–4 has partially answered this question by suggesting that appropriate institutional arrangements are important if EM firms are to enhance their innovation capabilities through exporting.

This study has identified three aspects of institutional development as particularly important: market openness, support for innovation, and the development of market intermediaries. When local innovation is encouraged, EM firms' exporting activities more readily promote product innovation. This finding highlights the importance of emerging home countries as a valuable source of knowledge. In addition to the positive direct effect, the positive moderating effect shows that local support for innovation is especially beneficial for exporters, who tend to have foreign knowledge they can combine with local knowhow. Similarly, the development of market intermediaries also benefits exporters more than non-exporters, though it tends to increase EM firms' product innovation in general.

A more open market reduces exporters' scope for information arbitrage, and their product innovation increase less with export value. While previous research has found that market openness and other market-supporting institutions have similar effects on the commercial activities in EMs (Doh, Teegen & Mudambi, 2004), this research has shown that sometimes they can have opposite effects. EM exporters in a less open market can take advantage of the limited access to overseas knowledge at home and innovate more actively than their non-exporting counterparts. There may be two reflections on this negative interaction effect. First, market openness may make non-exporters/less intensive exporters more innovative, so that an increase in exporting intensity does not increase firms' innovation performance as much as in less open economies. Market openness could also bring alternative sources of overseas knowledge to exporters, making them rely less on exporting for knowledge access.

The examination of hypothesis 4 has shown that EM exporters become more innovative by exporting to relatively similar overseas markets. This may be because firms can more effectively combine the knowledge acquired from destination countries with a similar level of institutional development. The additional analyses in this study were intended to try and figure out what made EM exporters learn less effectively from AEs. Better absorptive capacity for technology failed to predict more effective learning from more advanced countries, indicating that absorptive capacity for technology may not be the limiting factor. Even the Chinese exporters with greater absorptive capacity for technology did not demonstrate more innovation as a result of exporting more to advanced countries. The role of institutional distance in other aspects is therefore important. In this research, absorptive capacity was operationalized in terms of R&D intensity. Active R&D should help a firm better absorb advanced technology, but that may not be enough to overcome the learning difficulties created by a mismatch in the level of institutional development between the home and destination countries. EM firms may need to develop absorptive capacity not only for technology but also for coping with differences in different dimensions of institutions.

In addition to technical knowledge per se, techniques for managing innovation vary among countries with different institutions. For example, the constituent components of innovation systems and their interaction can be quite different. The major sources of knowledge can be quite different cross countries (Corredoira & McDermott, 2014). Where institutional voids prevail, firms need to develop techniques to manage *guanxi* rather than rely on intermediaries to search for or source knowledge. Where law enforcement is uncertain, firms learn to protect their knowledge through careful modularization, secrecy, and perhaps even co-opting the authorities (Cai, Huang & Li, 2014; Li & Xie, 2016; Zhao, 2006). For all these reasons, managing innovation in an environment with weak institutions can call for some special techniques. Institutional voids may distort the value of certain resources and capabilities acquired in better-developed markets

(Cuervo-Cazurra & Genc, 2008). Salomon (2006) has reported that exporting to advanced countries improved the innovation performance of Spanish firms. That seems to be consistent with the findings here, as Spain, a member of the OECD, would have a level of institutional development similar to that of other advanced economies.

Absorptive capacity hinges on multiple factors such as prior experience, accumulated knowledge, and the diversity of a firm's knowledge sources (Phene et al., 2006). It has been shown that firm-specific experience is not very helpful in dealing with institutional uncertainties (Henisz & Delios, 2001). This is consistent with the finding here that firms' investment in R&D does not help mitigate the learning difficulties caused by distances in institutional development. Experience in diverse institutional contexts abroad may help develop a capacity for dealing with institutional distance, but how to develop such a capacity still remains an interesting area for future research.

The findings are rather consistent across different measures of the variables. This may give them rich policy as well as managerial implications. EM governments usually encourage exporting in an early stage of development for two reasons. It of course earns foreign currency (Harwit, 1995), but beyond that, export performance is usually considered very persuasive evidence of technological upgrading (Thun, 2006). As EM economies develop over time, concern about exporting shifts to how it may enable EM firms to learn, with expectations that they would eventually climb up the value-added chain and start to innovate themselves. The results of this study suggest that institutions that promote local R&D and the development of market intermediaries at home complement export promotion policies and facilitate transforming exporters from knowledge recipients into knowledge creators. Open market policies, in contrast, may reduce the effectiveness of export promotion, as they weaken the information advantage of exporters. While the direct effects of market openness is positive, its indirect effects on innovation are usually negative for exporters.

The findings of this research call managers' attention to the information advantage EM firms gain by exporting when the market in their home region is not well integrated into the world market. They have a better chance to build up innovation capability before the market at home region is fully opened. Operating in regions with more R&D investment and better-developed market intermediaries helps EM exporters become more innovative by learning through exporting. Further, managers in EMs may be encouraged to pay more attention to destination countries which have a similar level of institutional development. Although the exposure to frontier technology may be limited in such markets, exporting to other EMs is nevertheless an effective way of improving a firm's innovation performance. Other EMs similar to an EM exporter's home can serve as an effective and inexpensive source of valuable knowledge, especially applied, experiential knowledge (Pietrobelli & Rabellotti, 2011). Access to this type of knowledge is very important to EM firms seeking to innovate (Amsden, 1989; Corredoira & McDermott, 2014).

Investment in R&D alone may not help a firm learn from countries with which there is a large gap in institutional development. Investment in what might be termed "institutional absorptive capacity" may be more important, but what that involves remains unclear. It should be noted that this study's focus on China should not be taken as circumscribing the applicability of the theoretical framework. The arguments about interaction between national-level and firm-level internationalization should apply to economies in all stages of development.

Taking advantage of the high variance in institutional development within China, this research teased out some potential unobservable, sub-national-level heterogeneities. The cost is that some readily available measures of national institutional development, such as tariff barriers and restrictions on foreign capital, could not be used. Future research might fruitfully extend this study by developing better operational measures of institutional variables at the national as well as the sub-national level. Another limitation of this research lies in the short panel data used to test the hypotheses, which did not allow analysis of longer-term effects. While it may be difficult to benefit from exporting to AEs in the short term, it is very likely that EM exporters benefit in the long run by gradually digesting and absorbing the advanced knowledge they can acquire by doing so. Economists have proposed another mechanism that links exporting and innovation – economies of scale. Exporting expands potential markets and enlarges the potential return to successful innovation. This may encourage firms to innovate (Hitt et al., 1997). While this may help to explain the central relationship between exporting and innovation, it fails

to explain the moderating effects found in this study. Future research which tests these competing explanations would clearly be helpful.

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